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SUGHRUE MION, PLLC 2100 PENNSYLVANIA AVENUE, N.W. SUITE 800 WASHINGTON, DC 20037			EXAMINER RUGGLES, JOHN S	
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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b> 10/642,657	<b>Applicant(s)</b> KOIKE ET AL.	
	<b>Examiner</b> John Ruggles	<b>Art Unit</b> 1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) ☒ Responsive to communication(s) filed on 16 July 2007.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) ☒ Claim(s) 1,2,4,5,9,10 and 15-21 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,2,4,5,9,10 and 15-21 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All    b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                                | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                       | 5) <input type="checkbox"/> Notice of Informal Patent Application                       |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## **DETAILED ACTION**

### ***Continued Examination Under 37 CFR 1.114***

A request for continued examination (RCE) under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicants' submission filed on 7/16/07 has been entered.

### ***Response to Amendment***

In the current 7/16/07 RCE amendment, claims 1-2, 4, and 19-20 are currently amended, claims 3, 6-8, and 11-14 are cancelled, claims 5 and 10 remain as original, and claims 9, 15-18, and 21 remain as previously presented. Therefore, only claims 1-2, 4-5, 9-10, and 15-21 remain under consideration.

The previous claims objections are withdrawn in view of the current amendment and accompanying remarks. The previous art rejections of the remaining claims under 35 U.S.C. 103(a) are re-written below, as necessitated by Applicants' current amendment.

Applicants' arguments with respect to claims 1-2, 4-5, 9-10/(1-2,4), 15-16, 17-18/(1-2,4), and 19-21 have been considered, but they are either unpersuasive or moot in view of the newly revised ground(s) of rejection set forth below (as necessitated by the current amendment).

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person

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having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-2, 9-10/(1-2), and 17/(1-2) are rejected under 35 U.S.C. 103(a) as being unpatentable over Berkey et al. (US Patent 6,265,115) in view of either Okamoto et al. (US 6,020,109) or Shoki et al. (US 2002/0110743), further in view of Jacquinet et al. (US 6,126,518) and Miura et al. (US 6,027,669) as evidenced by Grant et al. (Grant & Hackh's Chemical Dictionary, Fifth Edition, 1987), and further in view of either Nakamura et al. (US 5,429,730) or Hayden et al. (US 6,346,352).

Berkey et al. '115 teach projection lithography photomask blanks, preforms, and methods of making photomask blanks from a glass body that is subsequently post-treated (title, abstract). Photomask blanks and methods of making them suitable for lithography at a wavelength of 193 nm (corresponding to an ArF excimer laser) were previously known and have been popular (col. 2 lines 2-6). As shown by Figure 13, the method of making and post-treatment of photomask blanks taught by Berkey et al. '115 is suitable for photomask blanks used in lithography at wavelengths below 193 nm and particularly at 157 nm (vacuum ultraviolet, VUV, from an F<sub>2</sub> excimer laser, col. 10 lines 4-19). Post-treatment of the photomask blanks includes plural successive steps for progressively finer polishing, the last one or two steps of which include polishing the glass photomask blank with aqueous colloidal silica (having an average particle size  $\leq 50$  nm and a surface area of 200 m<sup>2</sup>/g or less) that is buffered to a pH of 8 to 12. The combined polishing steps achieve a finished surface having a root mean square (RMS) surface roughness  $\leq 0.15$  nm and an average surface roughness (Ra) of 5 Angstroms (0.5 nm) or less (col. 13 lines 33-57, this glass substrate surface polishing achieves a surface roughness that is suitable for glass photomask blanks to be used at least in ArF excimer laser (193 nm wavelength)

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lithography or in F<sub>2</sub> excimer laser (157nm wavelength) lithography, *instant claim 17/(1-2)*). This reference is silent about the particular type of inspection system used to detect the average and RMS surface roughness characteristics of the polished glass substrate surface. The polished glass photomask blank is patterned with a deposited Cr film to form a patterned transmission mask, preferably for use in VUV 157nm wavelength lithography, such as performed with a F<sub>2</sub> excimer laser (col. 13 line 58 to col. 14 line 3, *instant claims 9-10/(1-2)*).

While teaching methods of preparing a glass substrate for a mask blank to be exposed by either an ArF or an F<sub>2</sub> excimer laser that includes plural successive steps for progressively finer polishing of the glass substrate with aqueous colloidal silica to achieve a root mean square (RMS) finished surface roughness  $\leq 0.15$  nm, Berkey et al. '115 do not specifically teach: *[1]* that the colloidal silica has a pH between 7.0 and 7.6 (as required by *instant claims 1-2*); *[2]* that the colloidal silica was produced by hydrolysis of an organosilicon compound (*instant claim 1*); *[3]* that the colloidal silica has an alkali metal content of 0.1 ppm or less; *[4]* that the glass substrate is either *[a]* for a phase shift mask (PSM) blank or *[b]* for an EUV reflective mask blank (*instant claims 1-2*); nor *[5]* that the glass substrate has suppressed occurrence of a phase defect caused by a protrusion or a bump on the surface of the glass substrate (*instant claims 1-2*).

The *instant claim 1* colloidal silica abrasive grains are recited to be produced by hydrolysis of an organosilicon compound, which is recognized to be in product-by-process format. Therefore, the colloidal silica abrasive polishing liquid taught by Berkey et al. '115 would appear to be substantially similar to the *instant claim 1* polishing liquid containing colloidal silica abrasive grains (at least because the average particle size of  $\leq 50$  nm taught by Berkey et al. '115 clearly reads on Applicants' average particle sizes of 30-200 nm at instant

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page 22 lines 18-19 and 30-100 nm at instant page 27 lines 4-5, [2]), except that the colloidal silica polishing abrasive taught by Berkey et al. '115 has a pH of 8 to 12, which is higher than the instant pH of 7.0 to 7.6 for the colloidal silica abrasive (as recited by *instant claims 1-2*, from which instant claims 9-10/(1-2) depend).

Okamoto et al. teach an exposure method, a phase shift mask (PSM) therefore, and a method of making the PSM (title, abstract). Exposure using the mask with an excimer laser was previously known (col. 2 lines 1-3). The substrate for the PSM is quartz glass (col. 23 lines 51-58). The method of making the PSM with a synthetic quartz glass substrate includes polishing of the glass substrate before sputtering to deposit a light shielding thin film of Cr (to a thickness of e.g., 0.05-0.3  $\mu\text{m}$ , etc.), which is subsequently patterned by wet etching through an overlying patterned resist, as shown in Figures 19-20 (col. 24 lines 55-60, col. 25 lines 5-18, *instant claims 1-2*, [4]/a)). This reference shows the general state of the art for various features of the claimed invention.

Shoki et al. teach an EUV reflection mask blank having a glass substrate polished to a smoothness of 0.12 nm RMS, an intermediate layer, and an absorber layer of Cr and one or more of N, O, and/or C, as well as a process of making the EUV reflection mask (abstract, [0127], [0138], [0162]). The glass substrate is prepared to be superior in smoothness and flatness [0059]. The process of making the EUV reflection mask includes preparation of the glass substrate ([0058]-[0060]), multilayer thin film deposition (e.g., alternating layers of 28 Angstroms (2.8 nm) Mo and 42 Angstroms (4.2 nm) Si [0013], etc.), intermediate layer deposition ([0065]-[0068]), absorber layer deposition ([0103]-[0105]), electron beam resist patterning ([0107]-[0110]), and dry etching through the patterned resist to pattern the underlying

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absorber and the intermediate (optical) layers to make a patterned EUV reflection mask ([0111]-[0118]), as shown by Figure 2 (*instant claims 1-2, [4][b]*). This reference shows the general state of the art for various features of the claimed invention.

Jacquinet et al. teach a process for chemical mechanical polishing of material such as phosphosilicate glass or borophosphosilicate glass by colloidal silica particles at a neutral pH or a pH close to neutral (abstract). In Example 3, borophosphosilicate glass (BPSG) is polished with colloidal silica abrasive particles in suspension at neutral pH (pH=7), which exhibits a higher speed of attack, improved uniformity, and excellent planarization over Experiments 3 and 4 (col. 6 lines 24-51). The preferred conditions for the colloidal silica polishing particles in suspension include a pH of between 6 and 8, particularly a pH of 6.5 to 7.5 (col. 4 lines 12-16), with a neutral pH of 7 being exemplified in Example 3 (col. 5 line 61, reading on the instant pH of 7.0 to 7.6). A polishing process using a suspension of abrasive colloidal silica particles having such a neutral pH or a pH close to neutral (particularly at a pH = 6.5 to 7.5) allows good uniformity of polishing (e.g., of BPSG, etc.) while retaining a good speed of attack and excellent planarization (col. 6 lines 46-51). The instant recitation that the glass substrate is "for a mask blank" is an intended use that is not believed to be particularly limiting. Even so, the process of polishing glass by colloidal silica particles at a neutral or nearly neutral pH of 6.5 to 7.5 allows good uniformity for polishing glass while retaining a good speed of attack and excellent planarization, as taught by Jacquinet et al., is held to result in a glass substrate inherently able to act as a mask blank for producing a mask useful in lithographic processes for making optical recording media or semiconductor devices (*instant claim 2*).

Miura et al. teach a polishing composition containing silica (abstract) specifically contemplated to be useful for polishing a substrate such as a photomask (col. 1 lines 3-4). The polishing composition is further described to include colloidal silica, which is known to be made by a process such as hydrolysis of an organic silicon compound (col. 3 lines 26-32, *instant claim 1*). It is preferred that the colloidal silica polishing composition contains as little metal as possible (col. 3 lines 35-36, *[3]*, for a content of alkali metal in the colloidal silica for polishing of 0.1 ppm or less). This polishing composition has a pH of at least 7 for excellent stability during processing (e.g., for polishing a photomask containing a silicon dioxide ( $\text{SiO}_2$ ), etc., col. 6 lines 33-53, reading on *instant claims 1-2* for a pH of 7.0 to 7.6). Example 9 in Table 1 uses no additive and so would have a pH within 7.0 to 7.6. Examples 3 and 8 may also fall within this pH range based on the small amount of the weak base, potassium carbonate, added to the colloidal silica manufactured resulting in an alkali metal content of less than 0.1ppm. This reads on the instant polishing of a glass substrate for a mask blank within the scope of coverage sought, because the instant claims are read to embrace a multilayered substrate where the surface being polished is glass.

Grant et al. specifically define quartz as being silica or silicon dioxide ( $\text{SiO}_2$ , page 487) and further defines silica glass as having over 96%  $\text{SiO}_2$  (page 261), so it is clear that the  $\text{SiO}_2$  surface of Miura et al. is glass within the accepted meaning of the term.

It has been well-known for some time that when a bump or a protrusion defect occurs on a phase shifter (PS) of a phase shift mask (PSM), preferable pattern transfer cannot be performed properly in order to improve image resolution by the PS effect (as exemplified by Nakamura et al., col. 1 lines 12-16). In Nakamura et al., Figure 12A shows a bump or a protrusion defect 502



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of a silicon oxide (e.g., glass, etc.) phase shifter formed on a transparent quartz (e.g., glass, etc.) substrate 501. The thickness  $t$  of the phase shifter for inverting a phase is an odd-number multiple of  $t = \lambda / [2(n-1)]$ , where  $\lambda$  is the wavelength of an exposure light source and  $n$  is a refractive index. In this case, KrF is used as a light source ( $\lambda = 248$  nm), and a silicon oxide film ( $n = 1.508$ ) is used as a phase shifter (PS, col. 18 lines 30-40, [5]).

As an alternative to the teachings exemplified by Nakamura et al. (as discussed above), Hayden et al. teach that bump or protrusion defects 13 on the polished surface of a transparent (e.g., glass, quartz, etc.) substrate 10 of a PSM (as exemplified in Figure 1) should be removed or suppressed, in order to avoid adversely affecting or altering the PS of the transparent substrate (col. 1 lines 20-23, 41-45, col. 6 lines 33-48). Such masks are used with a variety of radiation sources, including visible, ultraviolet (UV), or X-ray (which includes EUV) sources (col. 1 lines 16-18, [5]).

It would have been obvious to one of ordinary skill in the art at the time of the invention in the method of producing a glass substrate for a photomask or a mask blank by polishing the surface of the glass substrate with aqueous colloidal silica abrasive having a buffered pH to achieve a root mean square (RMS) finished surface roughness  $\leq 0.15$  nm (reading on the *instant claim 17/(1-2)* RMS of 0.2nm or less) required for a glass photomask blank to be exposed by at least an ArF excimer laser (193nm wavelength) or a F<sub>2</sub> excimer laser (157nm wavelength, as taught by Berkey et al. '115), for suppressing the occurrence of protrusions or bumps that would otherwise cause phase defects on the surface of the glass substrate (in order to perform preferable pattern transfer that improves image resolution by the PS effect as taught by Nakamura et al. or alternatively to avoid adversely affecting or altering the PS of the transparent substrate as taught

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by Hayden et al. [5]) of a PSM (as taught by Okamoto et al., [4] [a]), or for an EUV reflective mask (as taught by Shoki et al., [4] [b]) to have alternatively adjusted the pH of the colloidal silica polishing liquid to (1) a pH of 6.5 to 7.5 to allow good uniformity of polishing the glass substrate while retaining a good speed of attack and excellent planarization (as taught by Jacquinet et al.) and to (2) a pH of at least 7 for excellent stability during processing while ensuring that the colloidal silica has a low alkali metal content (e.g., for polishing a silicon dioxide photomask substrate, etc., as taught by Miura et al. and evidenced by Grant et al., reading on the instant polishing of a glass substrate for a mask blank by colloidal silica having a pH of 7.0 to 7.6, *instant claims 1-2 [1]*, that has an alkali metal content of 0.1 ppm or less [3], etc.) with a reasonable expectation of gaining the benefits described. Further, it would also have been obvious to one of ordinary skill in the art to extend this method using known process steps by forming a thin film for causing optical change, such as a Cr light shielding thin film, on the polished glass substrate for a mask blank (*instant claim 9/(1-2)*) and then patterning the thin film to form a thin film pattern on a mask (e.g., a PSM, an EUV reflective mask, etc., as taught by Okamoto et al. or Shoki et al., *instant claim 10/(1-2)*).

Claims 4-5, 9-10/(4), 15-16, 17/(4), and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yoshikawa et al. (US 2003/0228461) in view of Watanabe et al. (US 6,277,465) and Maekawa et al. (US 5,868,953), further in view of Berkey et al. (US Patent 6,265,115) and either Okamoto et al. (US 6,020,109) or Shoki et al. (US 2002/0110743), and further in view of either Nakamura et al. (US 5,429,730) or Hayden et al. (US 6,346,352).

Yoshikawa et al. teach a method (e.g., in Examples 1 and 2, [0055]-[0059], etc.) for super precision polishing of a glass substrate by first and second super precision polishing steps

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(carried out successively) using silicon dioxide ( $\text{SiO}_2$ ) particles (abstract). In Example 1, the first or primary super precision polishing step on the glass substrate follows rough and precision polishing with cerium oxide and is carried out with a colloidal silica suspension having a pH of 3 at a weighting or pressure of  $30 \text{ g/cm}^2$  for 5 minutes to remove  $0.3\mu\text{m}$  of material (for an average polishing rate of  $0.06\mu\text{m/minute}$ ), while the second polishing step on the glass substrate is carried out with a colloidal silica suspension having a pH of 9.5 (reading on *instant claim 21* for an alkaline polishing liquid) at a weighting or pressure of  $30 \text{ g/cm}^2$  for 1 minute to remove  $0.03\mu\text{m}$  of material (for an average polishing rate of  $0.03\mu\text{m/minute}$ ) to obtain an average surface roughness ( $R_a$ ) of  $0.36 \text{ nm}$  (paragraphs [0056]-[0058], reading on *instant claim 15* for a polishing rate of  $0.12\mu\text{m/minute}$  or less to suppress protrusions and *instant claim 16* for a finer polishing (e.g., protrusion suppressing, etc.) step carried out successively after a previous polishing step (e.g., to control surface roughness, etc.)). The table on page 6 shows comparisons with other examples, including an average surface roughness ( $R_a$ ) of about  $0.2\text{nm}$  to  $0.42\text{nm}$  (reading on *instant claim 17/(4)* for a surface roughness of  $0.2\text{nm}$  or less) and a peak surface roughness ( $R_p$ ) of about  $1\text{nm}$  to  $5\text{nm}$  after super precision polishing.

While teaching plural steps for successively finer polishing on a glass substrate with the latter super precision polishing steps using colloidal silica at low weightings or pressures of  $30 \text{ g/cm}^2$  for successively lower average polishing rates of  $0.06\mu\text{m/minute}$  followed by  $0.03\mu\text{m/minute}$  to achieve a low  $R_a$  and a low  $R_p$ , Yoshikawa et al. do not specifically teach: *[4]* that the glass substrate is *[a]* for a PSM blank to be exposed by either an ArF or an  $\text{F}_2$  excimer laser or *[b]* for an EUV reflective mask blank; *[5]* that the glass substrate has suppressed occurrence of a phase defect caused by a protrusion or a bump on the surface of the glass

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substrate (*instant claim 4*); [6] that a thin film for causing an optical change in exposure light is formed on the glass substrate (*instant claim 9/(4)*); [7] that the thin film is patterned to produce a mask (*instant claim 10/(4)*); nor [8] plural polishing steps using colloidal silica at successively lower pressures to suppress the occurrence of a fine convex protrusion at the end of the polishing process (*instant claims 4-5*).

Watanabe et al. teach a glass substrate having a suppressed surface roughness, down to an average surface roughness  $\leq 1$  nm (title, abstract). This is achieved by plural polishing steps on the glass substrate, each at successively lower polishing pressures. The first polishing step uses cerium oxide in water at a polishing pressure of 150-300 g/cm<sup>2</sup> (col. 4 lines 33-56). The second polishing step also uses cerium oxide in water, but at a polishing pressure of 25-150 g/cm<sup>2</sup> (col. 4 line 57 to col. 5 line 3). The third polishing step uses colloidal silica (grain size of 0.2 microns or less) in water as the polishing liquid at a polishing pressure of 25-100 g/cm<sup>2</sup> (col. 5 lines 4-20). While this glass substrate is intended to be used for a magnetic information recording medium (title, abstract), this method of successively polishing the glass substrate is believed to be equally suitable for achieving a similar average surface roughness for a glass substrate intended for making a mask blank.

Maekawa et al. teach a method for polishing a glass substrate (abstract) having an improved surface characteristic (col. 1 lines 5-6) that includes plural polishing steps. Example 1 describes a first polishing of the glass substrate with a cerium oxide slurry in water having a pH of 7.4 at a polishing load or pressure of 120 g/cm<sup>2</sup> and then a second polishing of the glass substrate with colloidal silica having a pH of 9.5 at a polishing load or pressure of 60 g/cm<sup>2</sup> to obtain an average surface roughness (Ra) of 18 Angstroms (1.8 nm, col. 8 lines 40-62).

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The teachings of Berkey et al. '115, Okamoto et al., Shoki et al., Nakamura et al. and Hayden et al. are discussed above.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the method of Yoshikawa et al. by increasing the weighting or pressure from 30 g/cm<sup>2</sup> during the primary polishing step of the super precision polishing to reduce the time required based upon the teachings of the use of lower pressures in successive polishing steps by Watanabe et al. and Maekawa et al. [8]. Clearly, the increased pressure on the abrasive during earlier polishing step(s) would result in more aggressive polishing. Applicants are invited to compare the average and peak surface roughness after polishing achieved by the instant process with the results for average surface roughness (Ra) and peak surface roughness (Rp) after super precision polishing in the table on page 6 of Yoshikawa et al., noting that the Rp of Yoshikawa et al. is less than the 2 nm minimum peak height discussed by the instant specification in the last line on page 22 and that only examples 2-1, 2-2, 2-3, and 2-6 had final polishing pressures less than the 30 g/cm<sup>2</sup> used by Yoshikawa et al. in the secondary and final super precision polishing step. It is further noted that patterned masks would include those used to form optical recording media as well as those used to form semiconductor devices.

In addition to the basis given above, the examiner further holds that it would have been obvious to use the process for polishing other glass substrates, such as those for PSM blanks to be exposed by either an ArF or an F<sub>2</sub> excimer laser or for an EUV reflective mask blank, in which the surface of the glass substrate is polished for suppressing the occurrence of protrusions or bumps that would otherwise cause phase defects on the surface of the glass substrate (in order to perform preferable pattern transfer that improves image resolution by the PS effect as taught

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by Nakamura et al. or alternatively to avoid adversely affecting or altering the PS of the transparent substrate as taught by Hayden et al. *[5]*) of a PSM, so that the mask or photomask has a surface roughness required in an exposure wavelength to be used (as disclosed by Berkey et al. '115, Okamoto et al., and/or Shoki et al.) to make UV photomasks or masks (*instant claims 4-5, [4][a], [b]*). Furthermore, it would also have been obvious to use the resulting polished glass substrates to form a useful mask by providing a thin film for causing an optical change in exposure light on the glass substrate to produce a mask blank (*instant claim 9/(4), [6]*) and then patterning the thin film to produce a mask (*instant claim 10/(4), [7]*), as taught by Berkey et al. '115, Okamoto et al., and/or Shoki et al., with a reasonable expectation of forming a useful photomask or mask.

Claims 18/(1-2) and 19-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Berkey et al. (US Patent 6,265,115) in view of either Okamoto et al. (US 6,020,109) or Shoki et al. (US 2002/0110743), Jacquinet et al. (US 6,126,518) and Miura et al. (US 6,027,669) as evidenced by Grant et al. (Grant & Hackh's Chemical Dictionary, Fifth Edition, 1987), further in view of either Nakamura et al. (US 5,429,730) or Hayden et al. (US 6,346,352), and further in view of Oki et al. (US 5,581,345).

While teaching other aspects of the instant invention as discussed above, including a method for successively finer polishing of a glass substrate for a mask blank (suitable for exposure with an ArF or an F<sub>2</sub> excimer laser) using a colloidal silica suspension, for suppressing the occurrence of protrusions or bumps that would otherwise cause phase defects on the surface of the glass substrate, as well as achieving a root mean square (RMS) finished surface roughness  $\leq 0.15\text{nm}$  and an average surface roughness (Ra) of 5 Angstroms (0.5nm) or less, Berkey et al.

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'115, Okamoto et al. or Shoki et al., Jacquinot et al., and Miura et al. as evidenced by Grant et al. in view of Nakamura et al. or Hayden et al., do not specifically teach detecting a surface roughness defect by using a laser interference confocal optics inspection system after polishing of the glass substrate (*instant claims 18/(1-2) and 19-20*).

However, Oki et al. teach the advantageous use of a confocal laser scanning mode interference contrast microscope apparatus or system for a method of measuring minute step height (title, on a substrate surface). Probe-type microscopes (e.g., a scanning electron microscope (SEM), an atomic force microscope (AFM), etc.) are generally used for measuring minute step heights of nanometer order on the surface of an object (col. 1 lines 51-55). However, in such probe-type inspection systems measurement of the object surface requires a probe to be brought into contact with the surface of the object, so the object is liable to be damaged and the probe is often broken, necessitating replacement of the probe. Consequently, probe-type measuring systems are also disadvantageous from the viewpoint of cost (col. 1 lines 56-63). To overcome these disadvantages, Oki et al. use a non-contact type confocal interference laser inspection system that is compact, easy to manufacture (col. 2 lines 21-23), and is capable of measuring minute step or projection height on the surface of an object (such as a phase object, which reads on the surface of a PSM blank), even when the projection or defect on the surface of the object (which can be characterized as surface roughness) has a narrower width than a light spot utilized for the measurement. This confocal interference laser inspection system achieves high resolution (understood to be at least comparable to the resolution that would be obtained from a probe-type measuring system), but without being in contact with the surface of the object. Thus, such a confocal interference laser inspection system overcomes the

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disadvantages of damaging the surface of the object being tested and/or breaking the probe in probe-type measuring systems (col. 2 lines 24-29).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention in the method of using colloidal silica to finely polish a glass substrate having a very low finished surface roughness (e.g., a RMS surface roughness  $\leq 0.15\text{nm}$  and an average surface roughness (Ra) of 5 Angstroms (0.5nm) or less, as taught by Berkey et al. '115, etc.), in which the surface of the glass substrate is polished for suppressing the occurrence of protrusions or bumps that would otherwise cause phase defects on the surface of the glass substrate (in order to perform preferable pattern transfer that improves image resolution by the PS effect as taught by Nakamura et al. or alternatively to avoid adversely affecting or altering the PS of the transparent substrate as taught by Hayden et al.) of a PSM, so that the mask or photomask has a surface roughness required in an exposure wavelength to be used and the polished glass substrate is (a) suitable for either a PSM blank to be exposed with an ArF or an F<sub>2</sub> excimer laser or (b) suitable for a EUV reflective mask blank (as taught by Okamoto et al. or Shoki et al., Jacquinot et al., and Miura et al. as evidenced by Grant et al.), to have detected a defect (characterized as surface roughness) on the finished surface of the finely polished glass substrate by using a defect inspection system comprising laser interference confocal optics after polishing. This is because confocal interference laser inspection system optics do not require contact with the finely polished glass surface, while still achieving high resolution for characterizing surface defects or surface roughness, to avoid damaging the finely polished glass surface and/or to avoid breaking the probe in a comparable probe-type measuring system. Furthermore, such a non-contact type confocal interference laser inspection system is compact, easy to manufacture, and would be less



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costly to operate than a comparable probe-type measuring system (as taught by Oki et al., *instant claims 18/(1-2) and 19-20*).

Claim 18/(4) is rejected under 35 U.S.C. 103(a) as being unpatentable over Yoshikawa et al. (US 2003/0228461) in view of Watanabe et al. (US 6,277,465) and Maekawa et al. (US 5,868,953), further in view of Berkey et al. (US Patent 6,265,115) and either Okamoto et al. (US 6,020,109) or Shoki et al. (US 2002/0110743), further in view of either Nakamura et al. (US 5,429,730) or Hayden et al. (US 6,346,352), and further in view of Oki et al. (US 5,581,345).

While teaching other aspects of the instant invention as discussed above, including a method of successively finer polishing on a glass substrate using colloidal silica at low weightings or pressures of 30 g/cm<sup>2</sup> for successively lower average polishing rates of 0.06µm/minute followed by 0.03µm/minute to achieve a low Ra and a low Rp for a mask blank (suitable for exposure with an ArF or an F<sub>2</sub> excimer laser) using a colloidal silica suspension, for suppressing the occurrence of protrusions or bumps that would otherwise cause phase defects on the surface of the glass substrate, as well as achieving a root mean square (RMS) finished surface roughness ≤ 0.15nm and an average surface roughness (Ra) of 5 Angstroms (0.5nm) or less, Yoshikawa et al., Watanabe et al., Maekawa et al., Berkey et al. '115, and Okamoto et al. or Shoki et al. in view of Nakamura et al. or Hayden et al. do not specifically teach detecting a surface roughness defect by using a laser interference confocal optics inspection system after polishing of the glass substrate (*instant claim 18/(4)*).

However, the teachings of Oki et al. are discussed above.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention in the method of successively finer polishing on a glass substrate using colloidal silica

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at low weightings or pressures of  $30 \text{ g/cm}^2$  for successively lower average polishing rates of  $0.06 \mu\text{m/minute}$  followed by  $0.03 \mu\text{m/minute}$  to achieve a low Ra and a low Rp for a mask blank (suitable for exposure with an ArF or an  $\text{F}_2$  excimer laser) using a colloidal silica suspension, for suppressing the occurrence of protrusions or bumps that would otherwise cause phase defects on the surface of the glass substrate, as well as achieving a root mean square (RMS) finished surface roughness  $\leq 0.15 \text{ nm}$  and an average surface roughness (Ra) of 5 Angstroms ( $0.5 \text{ nm}$ ) or less that is (a) suitable for either a PSM blank to be exposed with an ArF or an  $\text{F}_2$  excimer laser or (b) suitable for a EUV reflective mask blank (as taught by Yoshikawa et al., Watanabe et al., Maekawa et al., Berkey et al. '115, and Okamoto et al. or Shoki et al. in view of Nakamura et al. or Hayden et al.) to have detected a defect (characterized as surface roughness) on the finished surface of the finely polished glass substrate by using a defect inspection system comprising laser interference confocal optics after polishing. This is because confocal interference laser inspection system optics do not require contact with the finely polished glass surface, while still achieving high resolution for characterizing surface defects or surface roughness, to avoid damaging the finely polished glass surface and/or to avoid breaking the probe in a comparable probe-type measuring system. Furthermore, such a non-contact type confocal interference laser inspection system is compact, easy to manufacture, and would be less costly to operate than a comparable probe-type measuring system (as taught by Oki et al., *instant claim 18/(4)*).

### ***Response to Arguments***

Applicants' arguments with respect to claims 1-2, 4-5, 9-10/(1-2,4), 15-16, 17-18/(1-2,4), and 19-21 have been considered, but they are either unpersuasive or moot in view of the newly revised ground(s) of rejection set forth above (as necessitated by the current amendment).

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Applicants' arguments on pages 6-13 of 13 now rely on newly recited limitations requiring suppressed occurrence of protrusions causing phase defects on the surface of the glass substrate, but these newly recited limitations are met by the revised rejections set forth in this Office action.

In response to Applicants' arguments that various previously cited references fail to teach certain recited limitations, the test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference; nor is it that the claimed invention must be expressly suggested in any one or all of the references. Rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981).

In response to Applicants' arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Even though individual references when taken separately do not teach all of the claimed limitations, these same references can still be relied upon when they are properly combined together in the art rejections under 35 USC 103(a) to collectively teach the claimed limitations.

In response to Applicants' arguments that Yoshikawa et al., Maekawa et al., and Watanabe et al. describe polishing of glass substrates for different intended uses than the instant polishing of a glass substrate intended to be used "for a mask blank", a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the

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prior art structure(s) are capable of performing the intended use, then they meet the claim(s) for the reasons previously given and now repeated in this Office action. As indicated in previous Office actions and again repeated above, Applicants are still invited to compare the average and peak surface roughness after polishing achieved by the instant process with the results for average surface roughness (Ra) and peak surface roughness (Rp) after super precision polishing in the table on page 6 of Yoshikawa et al., noting that the Rp of Yoshikawa et al. is less than the 2 nm minimum peak height discussed by the instant specification in the last line on page 22 and that only examples 2-1, 2-2, 2-3, and 2-6 had final polishing pressures less than the 30 g/cm<sup>2</sup> used by Yoshikawa et al. in the secondary and final super precision polishing step.

On page 12, Applicants argue incorrectly that use of confocal laser scanning interference optics for measuring minute step height taught by Oki et al. after polishing is only relevant to claim 18, but that this teaching is not relevant to claims 19-20. However, claim 19 lines 4-5 and claim 20 lines 4-5 each specifically recite detection of surface protrusion or bump defects by using this type of measurement system, so Oki et al. is clearly also relevant to claims 19 and 20, just as previously indicated and repeated in the above rejections of these claims.

In response to Applicants' other arguments on pages 6-13 that the references fail to show certain additional features of Applicants' invention, it is noted that the additional features upon which Applicants rely (e.g., suppression of phase defects caused by surface protrusions on the glass substrate (intended for a PSM blank) that would lead to significant changes in phase angle exceeding 20 degrees, specific alkali metals or heavy metals that are to be excluded from the colloidal silica abrasive, etc.) are not recited in the rejected claim(s). Although the claims are

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interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to John Ruggles whose telephone number is 571-272-1390. The examiner can normally be reached on Monday-Thursday and alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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